

OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

October 1 - October 7, 1999

Summary 99-40

Operating Experience Weekly Summary 99-40

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Table of Contents

EVENTS

1. ELECTRICIANS FAIL TO APPLY REQUIRED LOCKOUT/TAGOUT
2. SECURITY GUARD STRUCK BY FIRE DOOR
3. DEGRADED COMBUSTIBLE GAS GENERATION PROGRAM CAUSES VIOLATION IN FACILITY AUTHORIZATION BASIS
4. INCOMPATIBLE WASTE MIXING CAUSES HAZARDOUS GAS RELEASE
5. LARGE DRILL BIT FAILURE RESULTS IN NEAR MISS
6. LABORATORY HOOD FIRE

FINAL REPORTS

1. MISPOSITIONED VALVE CAUSES IMPROPER TRANSFER
2. MISUSED SWIVEL HOIST RING FAILS

OEAF FOLLOWUP ACTIVITIES

1. WEEKLY SUMMARY GOES TO ALL-ELECTRONIC DISTRIBUTION WITH ISSUE 99-44
2. CORRECTION TO WEEKLY SUMMARY 99-23, ARTICLE 6



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The Weekly Summary is available, with word search capability, via the Internet at http://tis.eh.doe.gov/web/oeaf/oe_weekly/oe_weekly.html. If you have difficulty accessing the Weekly Summary at this URL, please contact the ES&H Information Center, 1(800) 473-4375, for assistance. If you have additional pertinent information or identify inaccurate statements in the summary, please bring this to the attention of Jim Snell, (301) 903-4094, or e-mail address jim.snell@eh.doe.gov, so we may issue a correction.

EVENTS

1. ELECTRICIANS FAIL TO APPLY REQUIRED LOCKOUT/TAGOUT

On September 29, 1999, at Argonne National Laboratory—West, two electricians violated a work package requirement when they disconnected a push button to relocate it on an auxiliary boiler alarm/control panel without de-energizing the panel and applying a lockout/tagout to its power supply. An engineer checking the progress of the work noticed that the push button was disconnected, but the panel was still energized. He questioned the two electricians and determined that a lockout/tagout had not been applied before the electricians disconnected the push button. The engineer stopped the work and inspected the job site for other safety hazards. No personnel were injured as a result of this event, but the potential for injury existed because the electricians did not apply a required lockout/tagout. (ORPS Report CH-AA-ANLW-ANLW-1999-0007)

Investigators determined that the electricians were trained on the lockout/tagout procedure and were aware of the lockout/tagout requirement for the work. They participated in a pre-job briefing where a facility manager discussed the requirement for the lockout/tagout. Investigators also determined that the first step of the engineering package procedure to relocate the push button required the electricians to open and lockout/tagout the circuit breaker to isolate the 110-volt power supply for the panel, and close and lockout/tagout the cubicle door for the circuit breaker. The electricians skipped this step on the working copy of the procedure, and they began work by performing the second step of the procedure, which disconnected the push button. Facility managers ordered a one-day stand-down of all site services work and stressed with facility personnel the importance of observing lockout/tagout requirements. The managers placed the electricians on administrative leave and are developing appropriate corrective actions to prevent recurrence of this type of event.

OFAF engineers reviewed two similar lockout/tagout violation events. The first event occurred on August 5, 1999, also at Argonne National Laboratory—West. A maintenance specialist electrician violated a lockout/tagout requirement when he was assigned to disconnect the power leads to a 120-volt seal heater on the door of a cafeteria walk-in cooler. An electrical foreman instructed the electrician in a pre-job briefing and gave him a lockout/tagout authorization and tag to open, tag, and lock the local disconnect switch supplying power to the seal heater before he disconnected the power leads. The electrician instructed another maintenance specialist to open the switch while he disconnected and terminated the power leads. He next instructed the other specialist to reclose the disconnect switch. The electrician returned the lockout/tagout authorization and tag to the plant services electrical supervisor and explained that he chose not to apply the lockout/tagout because of the simplicity of the work. The electrician violated approved facility work control and lockout/tagout procedures, which require a lockout/tagout on any circuit greater than 50 volts whenever possible. (ORPS Report CH-AA-ANLW-ANLW-1999-0006)

The second event occurred on July 7, 1998, at the Strategic Petroleum Reserves Bayou Choctaw Site. A construction manager discovered three subcontractor electricians holding energized 480-volt power cables while cutting conduit with a band saw. He immediately directed the electricians to stop work and reported the event. Investigators determined that, although the electricians were trained and qualified, they cut the conduit in violation of their work permit and site safety procedures that required equipment to be locked out and tagged out. The subcontractors' manager administered appropriate disciplinary actions. (ORPS Report HQ--SPR-BC-1998-0003; Weekly Summary 98-29)

These occurrences underscore the importance of applying disciplined conduct of operations while complying with lockout/tagout (LO/TO) program requirements. A good LO/TO program is an important element of an effective conduct of operations program. DOE LO/TO programs serve two functions. The first, defined in 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, is to

protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status. The standard states that an effective LO/TO program requires three elements: (1) all affected personnel must understand the program, (2) the program must be applied uniformly in every job, and (3) the program must be respected by every worker and supervisor.

The LO/TO program is the primary barrier to employee injury or death. However, it is an administrative program that cannot work properly unless all individuals understand their responsibilities and carry them out with a high degree of discipline. Facility managers should ensure that all managers and supervisors understand their expectations for the LO/TO program and that they effectively communicate and enforce them with all facility personnel. These expectations should include attention to detail, verbatim compliance, effective communications, and defense in depth.

Facility managers should also review DOE/EH-0540, Safety Notice 96-05, "Lockout/Tagout Programs." The Notice states that workers must be cognizant of lockout/tagout boundaries and that they must verify that no hazardous energy exists within these boundaries. It also summarizes lockout/tagout events at DOE facilities, provides lessons learned and recommended practices, and identifies lockout/tagout program requirements. Safety Notices are available at http://tis.eh.doe.gov/web/oeaf/lessons_learned/ons/ons.html.

The *Hazard and Barrier Analysis Guide*, developed by OEAF, includes a hazard-barrier matrix that demonstrates that lockouts/tagouts provide the most effective barrier against injury. When implemented properly, a lockout/tagout provides a high probability (greater than 99 percent) of success for risk reduction. A copy of the guide is available at <http://tis.eh.doe.gov/web/oeaf/tool/hazbar.pdf>.

KEYWORDS: conduct of operations, lockout and tagout, maintenance, violation

FUNCTIONAL AREAS: Conduct of Operations, Industrial Safety, Electrical Maintenance

2. SECURITY GUARD STRUCK BY FIRE DOOR

On September 30, 1999, at the Pantex Plant, a security guard was struck by a fire door. The guard was sitting in a chair inside a doorway when the 10-foot by 16-foot, 200- to 300-pound fire door deployed, hit his shoulder, and stopped after contacting his lap. Electricians were troubleshooting problems in fire system interfaces and inadvertently caused the door to release when they activated a manual pull station. Safety personnel, the operations manager, the operations coordinator, and the facility manager were immediately notified of the event. Safety personnel began an investigation and requested that the guard be evaluated by site medical personnel. The guard stated that he was not hurt and refused a medical evaluation. Although no one was injured during this event, failure to understand the system configuration before performing work created a personnel safety hazard. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0068)

The security guard was stationed in the area to observe subcontractors who were performing work unrelated to the fire system troubleshooting work. Before the electricians began troubleshooting, they told the guard that an alarm would sound when they activated the pull station and that he should not evacuate when he heard it. Investigators determined that the electricians' drawings did not indicate that the fire door was held open magnetically and that it releases upon actuation of the manual pull station. They also determined that normally fire doors deploy when water is released from the sprinkler system and not when the manual pull station is activated. Facility personnel examined the door and found that it jammed and jumped off its track as a result of this event. They also determined that the door closure time is 6 to 24 seconds as required by the National Fire Protection Association. No signs or floor markings were present in the area to warn personnel of the potential for the door to close. The facility manager will continue to review this event and will develop corrective actions as necessary.

NFS has also reported system anomalies caused by maintenance or testing in several Weekly Summaries. Some examples follow.

- Weekly Summary 99-19 reported that a Rocky Flats Environmental Technology Site life safety/disaster warning (LS/DW) system became inoperable when an alarm technician interrupted power by opening and closing the main LS/DW breaker in an attempt to reset an intermittent trouble light. The breaker also supplied power to the facility criticality system tone generator. When the alarm technician closed the breaker, all power to the LS/DW was lost, resulting in an inoperable criticality tone generator and causing the broadcast of a constant clicking sound over the LS/DW speakers for approximately eight hours. A Station Technical Advisor (STA), an engineer, and alarm technicians repaired the system. However, they did not use a work package to perform the repair, and no one performed a post-maintenance test to verify system operability. (ORPS Report RFO--KHLL-ANALYTOS-1999-0009)
- Weekly Summary 98-38 reported that fire department personnel at the Hanford Site Plutonium Finishing Plant were performing a Halon system functional test when the Halon system discharged. The discharge occurred when electricians disconnected wires from a Halon tank pressure-monitoring instrument instead of a Halon discharge actuator. They were working under a generic work package for preventive maintenance of site fire protection systems. The work package did not provide details for deactivating the Halon system and did not include a wiring diagram. (ORPS Report RL--PHMC-PFP-1998-0040)

These events underscore the importance of using effective work control practices and job planning and being alert to potential hazards. A safety and health hazard analysis must be included in the work control process to help prevent injuries. In testing areas, construction areas, or areas where lifting operations are ongoing, personnel not involved in the actual operations need to ensure that they are at safe distances from the work.

These events also underscore the importance of verifying that installed configurations of equipment are correct and that testing or maintenance does not introduce configuration changes. Facility managers should ensure that maintenance activities are adequately controlled and that personnel understand the potential impact of these activities on safety systems. Managers should ensure that (1) tasks are controlled by procedure, (2) tasks are supported by accurate drawings or diagrams, (3) components or equipment are labeled properly, and (4) verification is performed to demonstrate that the task was performed correctly.

- DOE O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, states that the contractor must identify workplace hazards and evaluate the risks of associated worker injury or illness.
- DOE O 4330.4B, *Maintenance Management Program*, section 8.3.1, provides guidelines on work control systems and procedures. The Order requires using control procedures to help personnel understand the requirements for working safely.
- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, "Control of Equipment and System Status," states that managers of DOE facilities shall establish administrative control programs to handle configuration changes resulting from maintenance, modifications, and testing. It also states that the operating shift should know the status of equipment and systems, and it discusses communications necessary to maintain proper configuration control.

- DOE-STD-1073-93-Pt.1 and -Pt.2, *Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, provides guidelines and good practices for an operational configuration management program including change control and document control.

KEYWORDS: safety hazard, personnel safety, equipment

FUNCTIONAL AREAS: Industrial Safety, Hazards and Barrier Analysis, Configuration Control

3. **DEGRADED COMBUSTIBLE GAS GENERATION PROGRAM CAUSES VIOLATION IN FACILITY AUTHORIZATION BASIS**

On August 27, 1999, at the Rocky Flats Environmental Technology Solid Waste Treatment Facility, facility managers reported that the combustible gas generation program has degraded to an unsatisfactory condition because six tanks were not regularly sampled or purged as required by a facility operations order, violating the facility authorization basis. While performing a basis for interim operations review, an independent verification review (IVR) team discovered that sampling for hydrogen in four tanks and methanol in two tanks was not being performed. They determined that elevated concentrations of methanol and hydrogen have existed in the tanks on several occasions and that no mechanism is in place to ensure sampling or purging is completed. They also determined that, in some cases, purging of the tanks was performed before the tanks were sampled, invalidating sample results. This practice resulted in the inability to accurately trend gas generation rates. Gas generation rates are used to determine the proper periodicity for purging the tanks to prevent flammable or explosive gas accumulation. (ORPS Report RFO--KHLL-SOLIDWST-1999-0039)

The IVR team determined that hydrogen generation from radiolytic and organic decomposition is a concern for four of the tanks and that the chemical volatility and combustible nature of methanol is a concern for the remaining two tanks. They also determined that although a program was established to sample and purge the tanks, it was not properly followed as evidenced by the following examples.

- Facility personnel are required to sample the methanol tanks monthly and the hydrogen-generating tanks quarterly. However, from October 1997 until June 1999, the methanol tanks were only sampled nine times, and the hydrogen tanks were sampled sporadically.
- Facility personnel are required to purge tanks containing high levels of combustible gases in a timely manner. However, one methanol tank was sampled on August 14, 1998, and it contained 14.26 volume/percent combustible gases. The lower explosive limit (LEL) for methanol is 6 percent, and National Fire Protection Association guidelines require that combustible gas volumes must not exceed 25 percent of the LEL. However, no one purged this tank until September 16, 1998.

The DOE Facility Representative determined that the level of attention given to the methanol tanks is not commensurate with the significance of their fire hazard. He acknowledged that untimely laboratory sample results contributed to a delay in purging tanks on several occasions, and a turnover of facility managers failed to emphasize the combustible gas program. However, he stated, "To unilaterally decide not to meet the combustible gas program commitments and allow the program to degenerate to its current condition is unacceptable." DOE and facility managers will continue to review this event and will develop and implement corrective actions as necessary.

NFS has reported tank explosions in several Weekly Summaries. Some examples follow.

- Weekly Summaries 99-33 and 99-09 reported that a hydroxylamine tank explosion killed five people and injured several others at a Concept Sciences, Inc. chemical plant near Allentown, Pennsylvania. The blast completely destroyed a 45,000-square-foot section of the plant, damaged nearby buildings, and rained debris over a wide area. The blast also formed a crater approximately 18 feet in diameter and 4 feet deep in the building's concrete floor. (OSHA Regional News Release USDL 99-222)
- Weekly Summary 97-21 reported that a chemical explosion occurred and caused significant localized damage at the Hanford Plutonium Reclamation Facility in a room where non-radioactive bulk chemicals were mixed. Investigators determined that the explosion occurred in a tank that contained a solution of hydroxylamine nitrate and nitric acid. The tank initially contained a relatively dilute solution of hydroxylamine. However, because the tank was vented, evaporation caused the concentration of the reactants to increase over time resulting in a spontaneous chemical reaction that generated large quantities of steam and gas that overpressurized the tank. (ORPS Report RL--PHMC-PFP-1997-0023)

In addition, NFS has reported hydrogen buildup in tanks in several Weekly Summaries. Weekly Summary 95-09 reported an unreviewed safety question at Rocky Flats concerning the effects of hydrogen buildup in tanks. The results of a technical study on tank content decomposition determined that hydrogen could build up in actinide solution tanks if operators did not vent them. Operators plan to vent most of the storage tanks and drums as part of a new 1997 program. (ORPS Report RFO--EGGR-371OPS-1995-0037).

The Secretary of Energy issued "DOE Response to the May 14, 1997, Explosion at Hanford's Plutonium Reclamation Facility" on August 4, 1997. This memorandum states, "DOE field offices must reassess known vulnerabilities (chemical and radiological) at facilities that have been shut down, are in standby, are being deactivated, or have otherwise changed their conventional mode of operation in the last several years." It also states, "DOE and contractor field organizations must assess the technical competence of their staff to recognize the full range of hazards presented by the materials in their facilities, to act on results, and to implement training programs where needed." The Secretary of Energy also issued "Assessment of Hazards Associated with Chemical and Radioactive Waste Storage Tanks and Ancillary Equipment" on October 31, 1997. This memorandum states that DOE offices should ensure that all waste storage tanks are identified, fully characterized, and addressed.

The effects of hydrogen buildup in tanks are the same as those described in DOE/NS-0013, Safety Notice 93-1, *Fire, Explosion, and High Pressure Hazards Associated with Waste Drums and Containers*. This Notice provides references and lessons learned that can be applied to prevent hydrogen buildup in tanks. The chairman of the Defense Nuclear Facilities Safety Board stated in a July 15, 1995 letter to the assistant secretary for environmental management the staff's concern regarding flammable gas generation. On July 5, 1995, the Board transmitted a report to DOE detailing the results of a Board staff review of hydrogen in tanks and pipes at Rocky Flats. The Board requested a plan of action to aggressively address the hydrogen accumulation hazard.

These events highlight the need for comprehensive lessons learned and corrective action programs. If facility managers had incorporated lessons learned from either the Hanford tank explosion event or the 1995 Rocky Flats unreviewed safety question, a program for tank monitoring would be in place. One objective of investigating and reporting the cause of occurrences is to identify corrective actions to prevent recurrence and thereby protect the health and safety of the public, workers, and the environment. DOE M 232.1-1, *Occurrence Reporting and Processing of Operations Information*, requires trending and analysis of occurrence

information for early identification and correction of deteriorating conditions. The manual also requires dissemination of operations information, including lessons learned.

Lessons learned are valuable only if the information they communicate is utilized. DOE-STD-7501-95, *Development of DOE Lessons Learned Programs*, was designed to promote consistency and compatibility across programs. Lessons learned managers and program managers should review the standard and incorporate applicable elements into their site programs. Managers, supervisors, and operators should review lessons learned documents for applicability, and the information should be used to improve operations.

Facility managers should review the following for additional information.

- DOE-HDBK-1100-96, *Chemical Process Hazards Analysis*, February 1996, and DOE-HDBK-1101-96, *Process Safety Management for Highly Hazardous Chemicals*, February 1996, provide guidance for DOE contractors managing facilities and processes covered by the Occupational Safety and Health Administration (OSHA) Rule for Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119). Both handbooks are available at <http://www.doe.gov/html/techstds/standard/standard.html>.
- 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*, contains the requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals. It is available at http://www.osha-slc.gov/OshStd_data.
- DOE Defense Programs Safety Information Letter, SIL 96-01, *Incidents from Chemical Reactions Due to Lack of or Failure to Follow Proper Handling Procedures*, June 1996, provides guidance to prevent these incidents. Safety Information Letters can be obtained by contacting Tom Rotella, Defense Programs, Office of Engineering, Operations, Security, and Transition Support at (301) 903-2649 or thomas.rotella@dp.doe.gov.

Safety Notices can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to the U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874. Safety Notices are also available at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: tank, fire protection, fire safety, flammable, sampling

FUNCTIONAL AREAS: Fire Protection, Operations, Licensing/Compliance, Lessons Learned, Surveillance

4. INCOMPATIBLE WASTE MIXING CAUSES HAZARDOUS GAS RELEASE

On October 4, 1999, at the Savannah River Site Laboratory Technical Area, a laboratory technician mixed incompatible wastes in a waste drum, resulting in a chemical reaction that generated gas and pressurized the drum. Some of the gas escaped through a cap on the drum lid. The technician had incrementally added 20 liters of nitric acid waste from a carboy to a 55-gallon drum containing approximately 31 liters of alkaline waste without observing signs of a reaction. He hand-tightened a cap on the drum lid and left the area for approximately five minutes. When he returned, he noticed a brown gas seeping from the area around the cap, which facility personnel believe was the result of escaping nitric oxide. Emergency management personnel sent five potentially affected persons to the Site medical facility for evaluation, and they returned to work without restriction. Nitric oxide is immediately hazardous because it combines with moisture in the respiratory tract to form nitric acid. Low concentrations of nitric

oxide cause mild irritation to the mucous membranes, while high concentrations may cause severe respiratory injury. (ORPS Report SR--WSRC-LTA-1999-0032)

When the laboratory technician first noticed the gas, he inverted a beaker over the drum cap in an attempt to trap the gas. He then notified a researcher, and they placed a hose and funnel over the cap, routing the end of the hose to a nearby fume hood. Because of minor leakage of gas around the edge of the funnel, a second technician used cardboard boxes to assemble a hood that would fit over the entire drum. During this operation, the researcher noticed that the drum surface was very warm. An engineer slightly loosened the drum cap to measure the temperature of the drum contents with a thermocouple. Brown gas escaped again, and he immediately re-tightened the cap. The researcher notified the control room of the occurrence approximately 45 minutes after the gas was first noticed. No one in the general area of the drum during this time was wearing respiratory protection equipment.

Following a brief review of the situation and discussions with the facility safety engineer and industrial health personnel, the shift supervisor contacted the hazardous materials (HAZMAT) Team and evacuated personnel from the affected wing of the facility. The HAZMAT Team determined that the drum was intact and that the bottom was hot because of the reaction inside. Internal pressure prevented removal of the cap from the drum using a remote opener; however, the team was able to relieve the pressure in the drum using remote puncturing equipment. Laboratory personnel performed corrosion tests with samples of drum contents, which measured 1.2 using a pH meter. They determined that the 60-mil drum walls may corrode at the rate of 10 mils per day. The HAZMAT Team placed the drum into an overpack container, and facility personnel have neutralized the drum contents and transferred them to a new drum.

Investigators determined that a researcher had been performing corrosion experiments using nitric acid. After informal discussions with other facility personnel regarding the contents of a partially filled alkaline waste drum in the laboratory's satellite waste area, the researcher concluded that it would probably be okay to add nitric acid waste to it. He told the laboratory technician to add the acid in small increments. Although the researcher expected a chemical reaction, he did not anticipate the magnitude of the reaction that actually occurred.

The following are among several concerns identified by facility managers and investigators.

- The combined wastes were not compatible, and the evaluation of waste compatibility was inadequate.
- Adding acid to a carbon steel drum in a satellite accumulation area is not an acceptable practice.
- The procedure for mixing accumulated waste is inadequate and confusing, and it does not require an appropriate level of user knowledge.
- The material that was added to the satellite accumulation area was not consistent with the purpose of the area.
- No arrangements were made to vent the expected off-gas before adding the nitric acid waste.
- No formal job hazard analysis was performed.
- Information flow was inadequate; operating personnel and the HAZMAT Team were not notified immediately upon discovery of the problem.
- Installing a cap on a drum that is off-gassing created a drum pressurization hazard.
- Approximately 2-1/2 hours elapsed before potentially affected personnel were sent for medical evaluation.

NFS has reported other events where workers created hazardous conditions by mixing incompatible materials. Some examples follow.

- Weekly Summary 99-39 reported that a hazardous waste management contractor at the Lawrence Livermore National Laboratory was sprayed with a slurry of Raney

nickel when the cap of a hazardous waste container blew off. Approximately 2.5 ounces of the slurry was released, spraying the contractor and the ceiling. He was preparing waste containers for shipment to an off-site waste disposal facility and violated procedures by adding water to the container. The water reacted with the Raney nickel releasing hydrogen and pressurizing the container. (ORPS Report OAK--LLNL-LLNL-1999-0045)

- Weekly Summary 99-09 reported that a subcontractor at the Weldon Spring Site Remedial Action Project Water Treatment Plant was sprayed with acid when he inserted a pump that he had been using to pump hydrochloric acid into a drum of sulfuric acid. When the two acids mixed, a violent chemical reaction sprayed acid from the drum approximately 10 feet to the ceiling and onto the employee. The employee received treatment and evaluation at a local hospital and was placed on light duty for three days. (ORPS Report ORO--MK-WSSRAP-1999-0004)
- Weekly Summary 98-18 reported that an employee at the Lawrence Livermore National Laboratory received chemical burns to his face when a plastic bottle pressurized, ruptured, and sprayed its contents. Investigators determined that the bottle contained sulfuric acid, nitric acid, and acidified hydrocarbon oil. (ORPS Report SAN- -LLNL-LLNL-1998-0025)

These events underscore the importance of properly identifying and understanding the risks involved in working with hazardous chemicals. In facilities where hazardous chemicals are used, workers should be trained in the proper methods for handling, mixing, and storing these chemicals. Facility managers should emphasize the importance of researching all available sources of chemical safety information, particularly when performing first-time or infrequent operations. Information about chemicals, chemical hazards, and chemical safety programs may be located on the DOE Office of Environment, Safety and Health, Office of Worker Safety, Chemical Safety Program home page. The home page is located at http://tis-hq.eh.doe.gov/web/chem_safety/. It provides links to many sources of information, including requirements and guidelines, lessons learned, chemical safety networking, and chemical safety tools.

The following DOE and industry documents provide valuable guidance for all personnel who work with chemicals and hazardous materials.

- DOE-HDBK-1100-96, *Chemical Process Hazards Analysis*, and DOE-HDBK-1101-96, *Process Safety Management for Highly Hazardous Chemicals*, provide guidance for DOE contractors managing facilities and processes covered by the OSHA *Rule for Process Safety Management of Highly Hazardous Chemicals* (29 CFR 1910.119). Both handbooks are available on the DOE Technical Standards home page at <http://www.doe.gov/html/techstds/standard/standard.html>.
- DOE Defense Programs Safety Information Letter, SIL 96-01, *Incidents from Chemical Reactions Due to Lack of or Failure to Follow Proper Handling Procedures*, provides guidance on preventing accidental chemical reactions as a result of improper chemical storage, handling, shipping, and mixing. Safety Information Letter 96-01 is available at <http://www.dp.doe.gov/Public/default.htm>.
- 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*, provides direction on the use of chemicals. It covers signs and labels, spills and accidents, basic rules and procedures, and training and information. 29 CFR 1910.1450 is available on the OSHA home page at http://www.osha-slc.gov/OshStd_data.

- The Office of Environment, Safety and Health provides information in DOE/EH-0296, Bulletin 93-2, *Mixing of Incompatible Chemicals*, about the hazards associated with mixing incompatible chemicals.
- DOE/EH-0557, Safety Notice 97-01, *Mixing and Storing Incompatible Chemicals*, contains lessons learned related to the mixing and storing of incompatible chemicals. It also references a list of chemical incompatibilities provided by the University of Michigan. A copy of the list is available at <http://www.orcbs.msu.edu/chemical/chp/appendixc.html>. Safety Notice 97-01 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Rd., Germantown, MD 20874. Safety Notices are also available on the OEAF home page at http://tis.eh.doe.gov/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: chemical reaction, hazardous material, occupational safety

FUNCTIONAL AREAS: Industrial Safety, Materials Handling/Storage

5. LARGE DRILL BIT FAILURE RESULTS IN NEAR MISS

On September 28, 1999, at the Argonne National Laboratory—East Engineering Research Facility, as a drilling crew attempted to remove a large core-drilling bit from a hole with a 3-ton overhead crane, the cap of the bit separated causing the crane hook and the cap to recoil upward 10 feet. The hook and the cap of the bit became tangled in the crane cables, and the rest of the bit remained in the hole. The drill bit was 8-feet 2-inches long by 10 inches in diameter and weighed approximately 300 pounds. The crew had completed over-boring a hole in the rod storage area of the abandoned CP-5 reactor and had attached a lifting fixture to the bit to allow the overhead crane to remove it. The work crew and crane operator were located a safe distance from the lifting activity and were not injured. Although there were no injuries in this event, mechanical failures while a rigging is under strain is dangerous because of possible missile hazards. (ORPS Report CH-AA-ANLE-ANLEER-1999-0013)

The crew was involved in decontamination and decommissioning (D&D) activities at the CP-5 reactor, a heavy water graphite research reactor built in 1952 and abandoned in 1979. The fuel and most of the ancillary research equipment had already been removed from the reactor building. The drill was being used to over-bore 76 control rod storage holes to remove excess concrete allowing for the removal of metal sleeves. The crew was removing the drill bit after working on the 48th hole. Before beginning the lift, they attached an eyebolt to the cap of the bit and verified that the drill bit was free by rotating it in the hole. A qualified crane operator inspected the rigging and then raised the drill bit several inches. The crew observed the drill bit to be free and moving smoothly, when it suddenly jammed and the cap separated from the rest of the bit. The crew shut off the power to the crane and notified a health and safety officer and project management.

The CP-5 D&D project manager prohibited further use of this type of drill bit until the manufacturer provides information demonstrating that the drill bits were properly designed for lifting. An inspection of the crane and cabling by a qualified inspector was scheduled. Safety personnel classified this event as a near miss to personnel injury because the one remaining barrier was the safe positioning of personnel.

Investigators determined that the welded pins connecting the top cap to the drill bit had failed allowing the cap to separate from the rest of the bit. They believe the pins failed either when the bit jammed in the hole or from fatigue during use. They also determined that procedures requiring the use of a load cell during hoisting of the drill bit were not followed because the crew

did not use a load cell. OEAF engineers will continue to follow this event while the investigation continues and will provide additional information as it becomes available.

NFS reported a hoisting and rigging mishap that also occurred during decommissioning activities at the CP-5 Reactor in Weekly Summary 99-21. A nylon lifting sling broke when riggers were attempting to remove a 400-pound beam port casting from the face of a concrete monolith (biological shield) using the reactor building polar crane. The recoil caused the crane block to swing over but it did not hit the reactor monolith. The riggers believed that the casting was loose from the monolith and attempted three times to remove it; however, the casting was supported from underneath by metal supports that had not been detached. The sling broke during the third attempt to remove the casting. An inspection after the incident showed that the sling had been severed and that the casting contained sharp edges that could have cut the sling. Investigators also determined that the riggers had not attached a load cell to the crane. (ORPS Report CH-AA-ANLE-ANLEER-1999-0008)

DOE-STD-1090-99, *Hoisting and Rigging*, provides guidance for hoisting and rigging and identifies related codes, standards, and regulations. Section 12.8, "Load-Indicating Devices," provides guidance for the use of load-indicating devices or load cells. It recommends using load-indicating devices where the equipment/tackle configuration could bind the load, which would place a greater stress on the hoist or tackle than would be expected from the apparent hook load.

KEYWORDS: crane, drill, decontamination & decommissioning, hoisting and rigging, industrial safety

FUNCTIONAL AREAS: Decontamination and Decommissioning, Hoisting and Rigging, Industrial Safety

6. LABORATORY HOOD FIRE

On September 23, 1999, at the Idaho National Environmental and Engineering Laboratory, a fire occurred in a laboratory hood at the Advanced Test Reactor as an operator filled a cylinder with compressed hydrogen gas. The operator was passing hydrogen at low pressure through the cylinder to purge it of unwanted gasses and liquids. As the operator closed the cylinder outlet valve, a quick-disconnect fitting attached to Tygon® tubing disconnected, allowing hydrogen gas to escape. Investigators believe that the metal fitting struck the metal laboratory hood and generated a spark, igniting the escaping hydrogen, and producing a jet of fire. The operator quickly closed the hydrogen supply valve and the flame self-extinguished. He observed a plastic beaker and a section of plastic tubing smoldering, so he sprayed them with a small amount of water to cool them. This event is significant because of the potential hazards associated with flammable gases. It is important to consider all ignition sources when working with flammable gases. (ORPS Report ID--LITC-ATR-1999-0018)

The operator informed the Advanced Test Reactor shift manager of the fire and inspected the ventilation system ducting for evidence of fire. Although the operator determined that there was no ongoing fire in the ducting, he discovered smoke in a room downstream of the laboratory hood high-efficiency particulate air (HEPA) filters, indicating a failure of the filters. Figure 6-1 shows the laboratory hood set-up.

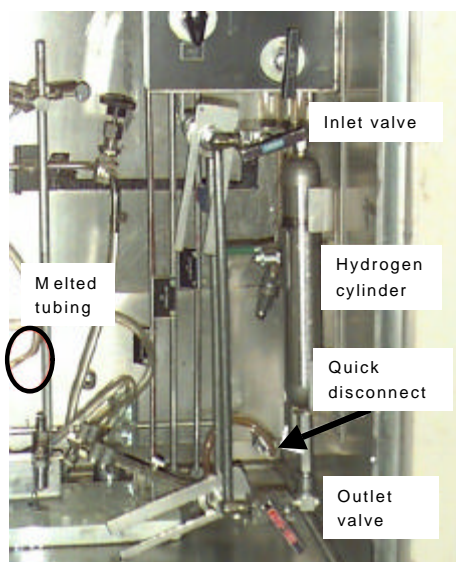


Figure 6-1. Laboratory Hood Set-up

Investigators removed the HEPA filters and discovered that they were charred. They believe that fine, lint-like particulates inside the ductwork upstream of the HEPA filters were ignited by the hydrogen fire. OEAF engineers will follow the investigation and provide additional information, as it becomes available.

KEYWORDS: fire, HEPA filter, hood, hydrogen, quick disconnect

FUNCTIONAL AREAS: Fire Protection

FINAL REPORTS

This section of the OEWS discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. MISPOSITIONED VALVE CAUSES IMPROPER TRANSFER

On July 19, 1999, at the Savannah River Site F-Canyon Area, facility operators transferred process water to an unintended location because a valve was not fully closed. The operators were using clean process water to verify a flow path from a head tank to a waste evaporator feed tank. Shortly after initiating flow, they noticed that the level in the feed tank was not rising, but instead, the level was rising in a second vessel that should have been isolated. They stopped the flow after approximately 90 gallons of process water had been transferred. Investigators determined that an isolation valve from the transfer header to the second vessel was not fully closed even though it was independently verified as being closed. This occurrence is significant because inadvertent or improper transfers of solutions can result in the mixing of incompatible chemicals or solutions, tank overflows, contamination of clean systems, or criticality safety implications. (ORPS Report SR--WSRC-FCAN-1999-0017)

Investigators determined that facility personnel were preparing to start an Americium and Curium pretreatment process that had not been used for approximately 10 years. The mispositioned valve is a one-inch, chain-operated gate valve located approximately 10 feet above the operating floor, partially obscured by other piping. Because of the small size of the valve, a guard over the operating chain interferes with visual observation of the stem position.

Additionally, the valve had been in its normal open position for several years. The operator who initially positioned the valve turned it in the closed direction until he felt resistance. The independent verifier checked the valve position in the closed direction and also felt resistance indicating that the valve was closed. Following the occurrence, a building supervisor directed an operator to open the valve fully and then reclose it. After cycling the valve several times in this manner, the operator was able to close it satisfactorily. Investigators believe that the operating chain may have become bound in the chain guard during initial positioning of the valve.

Facility managers attributed the direct and root causes of this occurrence to personnel error, specifically inattention to detail. Procedures permit an independent verifier to check the position of a valve in the closed direction only. The option to cycle the valve to assure proper seating, which was available to the first operator, was not performed.

Investigators identified two additional issues during their investigation of this occurrence.

- An engineer developed a preliminary checkout procedure for the transfer that specified a particular inlet nozzle on the evaporator feed tank. He checked control room diagrams to identify the transfer route to the intended nozzle and referenced an existing procedure to establish the transfer line-up. He assumed that the procedure was correct without reviewing it. However, the procedure he referenced used a different nozzle on the feed tank. The engineer walked down his intended transfer route, but without reviewing the procedure that he had referenced, he did not realize that it specified a route different from the route actually intended. One operating crew performed the preliminary checkout procedure, and a different crew performed the transfer line-up procedure several shifts later. Investigators believe that this delay contributed to the operators' failure to recognize a routing conflict between the checkout and line-up procedures.
- Investigators discovered a blank flange in the route established in accordance with the referenced procedure, i.e., the route using the unintended nozzle. The engineer failed to detect the blank flange because he had walked down the intended route rather than the route established by the procedure. Operators did not detect the blank flange because it was not included in a diagram attached to the line-up procedure.

Corrective actions for these issues are specific to the operation in progress but they can be applied to any new or modified transfer operation. They include engineering walk-downs of all procedures, including support procedures, to ensure compatibility with process requirements and walk-downs of piping references to identify and correct deficiencies.

This occurrence underscores the importance of diligence and good conduct of operations to ensure the safe operation of facilities and equipment, particularly when returning equipment to service after extended dormant periods. Although this event occurred during a preliminary checkout and had no adverse impact on the facility or personnel, it is typical of the type of event that could yield adverse results during actual operation. Solutions containing fissile materials can experience inadvertent criticality. For many solutions, reactions between incompatible chemicals can produce explosive, corrosive, or gas-generating mixtures. There is also the potential for off-site release of radiation or hazardous chemicals. DOE Defense Programs Safety Information Letter SIL 95-05, *Inadvertent Transfer of Liquid Solutions*, June 1995, addresses the safety problems caused by inadvertent transfers of solutions and includes recommendations for preventing or mitigating inadvertent liquid transfers. A copy of SIL 95-05 can be obtained by contacting Tom Rotella, Defense Programs, Office of Engineering, Operations, Security, and Transition Support, at (301) 903-2649 or thomas.rotella@dp.doe.gov.

KEYWORDS: conduct of operations, transfer, valve

FUNCTIONAL AREAS: Conduct of Operations

2. MISUSED SWIVEL HOIST RING FAILS

On July 27, 1999, at the Oak Ridge National Laboratory, a site rigging crew misused swivel hoist rings as tie-down points for a shielded cask causing one of them to fail. The ring failed while the riggers were attempting to lift the empty 4,700-lb cask from a truck. The crew was using two swivel hoist rings to lift the cask, and the pins on one of the rings failed while they attempted the lift. The swivel hoist rings, manufactured by The Crosby® Group, Inc., have a working load limit of 4,000 lb. Investigators believe that the riggers overstressed the rings when they were used as tie-down points while the cask was being transported. The position of the swivel hoist rings was contrary to the manufacturer's recommendations for their proper use when they were cantilevered over the side of the cask and used to chain the cask to the truck. (ORPS Report ORO--ORNL-X10CHEMTEC-1999-0014; Weekly Summary 99-31)

Investigators destructively tested two new swivel hoist rings of the same model. They pulled one of the new rings vertically (with the ring perpendicular to the attachment plane), and it failed at 24,000 lbs. They pulled the second new ring horizontally (with the ring parallel to the attachment plane), and it failed at 20,000 lbs. The ring that was pulled vertically failed similarly to the in-service ring that failed due to shearing of the support pins. The swivel collar failed on the ring that was pulled horizontally. Investigators examined the rings that were tested under a microscope and did not find any manufacturing defects. Metallurgical experts examined the swivel hoist ring that failed in service and did not find any indication of fatigue failure. From the testing data, examination of the failed in-service ring, and observations of indentations on the cask, investigators concluded that the swivel hoist rings on the cask were not defective and that the rigging crew overstressed them by misusing them as tie-down points during transit of the cask. Figure 2-1 illustrates proper and improper use of swivel hoist rings.

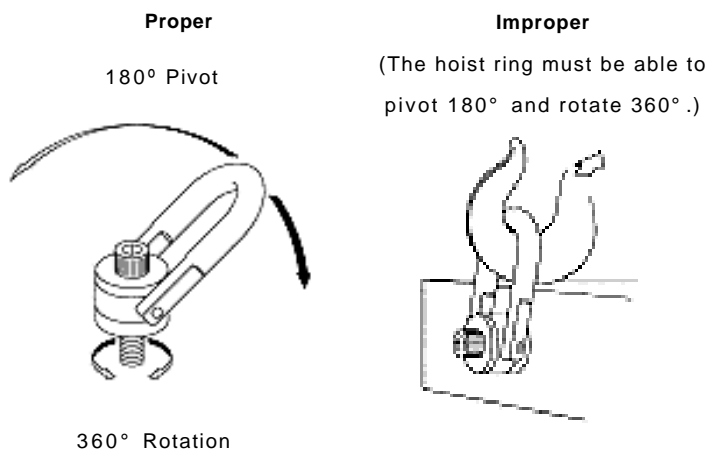


Figure 2-1. Use of Swivel Hoist Rings

Investigators determined that the direct cause of the event was a defective or failed part because the swivel hoist ring failed when it was subjected to excessive force while it was used as a tie-down fixture, a configuration not recommended by the manufacturer.

Investigators identified three contributing causes for this event. The first cause was personnel error. Under schedule pressures to transfer the cask, the rigging crew did not identify the use of the swivel hoist rings in the tie-down configuration as a misuse of the devices contrary to the manufacturer's recommendations. They should have delayed transfer of the cask until a proper tie-down fixture was available. The second cause was a design problem in that a tie-down fixture was not designed and fabricated for the cask. The cask designers knew that it would be transported on the truck and should have designed and fabricated a tie-down fixture for that use.

The third cause was a training deficiency. The improper use of swivel hoist rings had not been emphasized in crane and forklift training, a requirement for the users of the swivel hoist rings.

Investigators determined that the root cause of the swivel hoist ring failure was a management problem. Facility managers failed to establish an environment where operating and support personnel viewed compliance with procedures, safety rules, and good working practices as more important than meeting schedules.

Facility managers implemented the following corrective actions to prevent recurrence of this event.

- Facility supervisors reviewed the proper use of swivel hoist rings with rigging crews and incorporated information on their improper use into site rigging, crane, and forklift training.
- Facility personnel will design and fabricate a proper tie-down fixture for the cask if riggers are required to transport the cask in the future.
- Facility designers will revise the design control procedure to include a checklist item during the component design process that addresses special transportation fixture and tie-down needs.
- Facility managers will issue (1) a lessons learned document to highlight the proper use of swivel hoist rings, (2) a letter to site design organizations to stress the need to address tie-down considerations during the design process, and (3) a safety bulletin on the procurement, control, and testing of hoisting and rigging accessories.
- Facility managers will stress to operating personnel and support organization supervisors the importance of following procedures, safety rules, and good operating practices, even when schedule pressures are present.

KEYWORDS: design deficiency, hoisting and rigging, lessons learned, lifting device, rigging, training and qualifications

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety

OEAF FOLLOWUP ACTIVITIES

1. WEEKLY SUMMARY GOES TO ALL-ELECTRONIC DISTRIBUTION WITH ISSUE 99-44

The Office of Operating Experience, Analysis, and Feedback (EH-33) is discontinuing general hard-copy distribution of the Operating Experience Weekly Summary via U.S. Mail beginning with Issue 44, week of October 29-November 4, 1999. EH-33 will continue to distribute the weekly summary via electronic media. Readers can view the weekly summary in pdf or html at the EH-33 Lessons Learned website at (<http://www.tis.eh.doe.gov/oeaf/ll.html>) or from the EH Portal at <http://tis.eh.doe.gov/portal/>. EH-33 will also send the weekly summary electronically to customers who elect to subscribe to this service. The summary can then be printed for local hard-copy distribution. Any customers who do not have electronic access to the weekly summary should contact Jim Snell, OEWS Program Coordinator, at (301) 903-4094 or jim.snell@eh.doe.gov. We will attempt to make arrangements for you to obtain the weekly summary by other means. The next issue of the weekly summary will contain a new form for the all-electronic distribution service.

2. CORRECTION TO WEEKLY SUMMARY 99-23, ARTICLE 6

In Weekly Summary 99-23, the article titled "Inadequate Emergency Response To Chemical Spill" incorrectly stated that an emergency response team had entered the room (in response to a methylacrylate spill) without taking appropriate precautions in preventing ignition of the vapors or in responding to a fire, if one had occurred. In fact, the entry team did use standard protocols for entry into the room and their personal protective equipment (PPE) was appropriate. They carried a GasTech GX-82 direct-reading combustible gas indicator (CGI) to determine ambient levels of methylacrylate in the room. They were instructed to observe the reading(s) on the CGI and to immediately leave the room if detected levels met or exceeded 10 percent of the lower explosive limit. The entry team reported no detectable readings on the CGI during the entry, which lasted approximately one minute. A safety briefing was conducted before the entry, and backup personnel wearing PPE were available in the event that assistance was required. (ORPS Report ALO-LA-LANL-TA55-1999-0032)

KEYWORDS: chemical spill, flammable, hazardous material, volatile

FUNCTIONAL AREAS: Chemistry, Fire Protection, Industrial Safety